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NAVAL AIR DEVELOPMENT CENTER

Johnsville, Warminster, Pennsylvania

Report No. NADC-AE-7007 7 Apr 1970

NEW PLAN FOR INTEGRATED AVIONICS SYSTEM ARCHITECTURE

TECHNICAL NOTE
AIRTASK NO. A36533/202/70F15224601
Work Unit No. 3

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DEPARTMENT OF THE NAVY
NAVAL AIR DEVELOPMENT CENTER
JOHNSVILLE
WARMINSTER, PA. 18974

Aero-Electronic Technology Department

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Reported by: J. B. Power, H. B. Stein
J. B. Power H. B. Stein
Command and Control Division

Approved by: E C Johnson
E. C. Johnson, Superintendent
Command and Control Division

D W Mackiernan
D. W. Mackiernan
Technical Director

INTRODUCTION

The architectural plan for assembling a naval avionics system has been to wire together a conglomerate of electronic "black boxes."

In the early 1950's, a concept was launched to integrate a communications, navigation, and identification (CNI) subsystem by assembling all black boxes into one rack or case. The developed subsystems bear the designation, AN/ASQ-( ).

More recent advances have been made in the integration of avionics systems with the development of the Integrated Helicopter Avionic System (IHAS) and the Integrated Light Attack Avionics System (ILASS). However, a step backwards from the integrated concept has been taken in the electronics architecture of recent Navy aircraft, specifically the P-3C and the S-3A, which revert to the conglomerate concept. The S-3A will, however, have multiplexing interconnecting the communication subsystem.

This technical note introduces a new concept developed by the Naval Air Development Center for the total integration of all the avionics systems in the airplane.

SYSTEM CONCEPT

The Integrated Avionics System Architecture (IASA) concept is visualized for a fully integrated aircraft avionics system. It contains individual functional components, such as r-f and i-f amplifiers, frequency control synthesizers, audio amplifiers, detectors, and displays. These functional components are time-shared and interconnected through a central programmer control device. The central programmer controls the functions automatically, placing them in their preprogrammed configurations. Integrated antenna systems for uhf communications, navigation, identification, and electronic warfare detection are used and time-shared, receiving their instructions from the central programmer.

The Multiple Interior Communications System (MINCOMS) (a multiplexing concept and technique developed by NAVAIRDEVCEN to provide simultaneous signal flow and communications between avionics functions and crew members over twisted pair or coaxial cables) will provide the "highway" for the flow of the programmer digital instructions, as well as all other signals, digital and analog. Power switching and control, timing references, frequencies, computer control, in-flight performance monitoring (IFPM), functional fault diagnosis to replaceable levels, display signal flow, sensor signals, engine health sensor signals, airfoil control, weapons stores status and control, and other system functions are interconnected through the MINCOMS system.

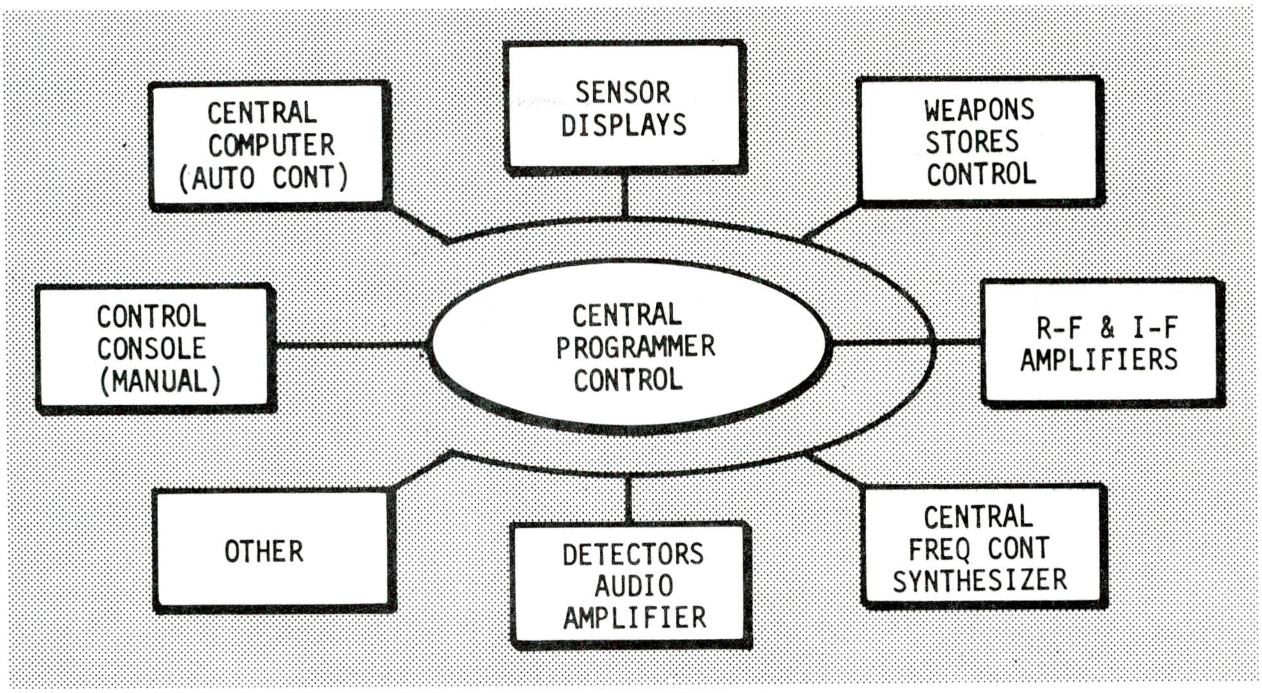
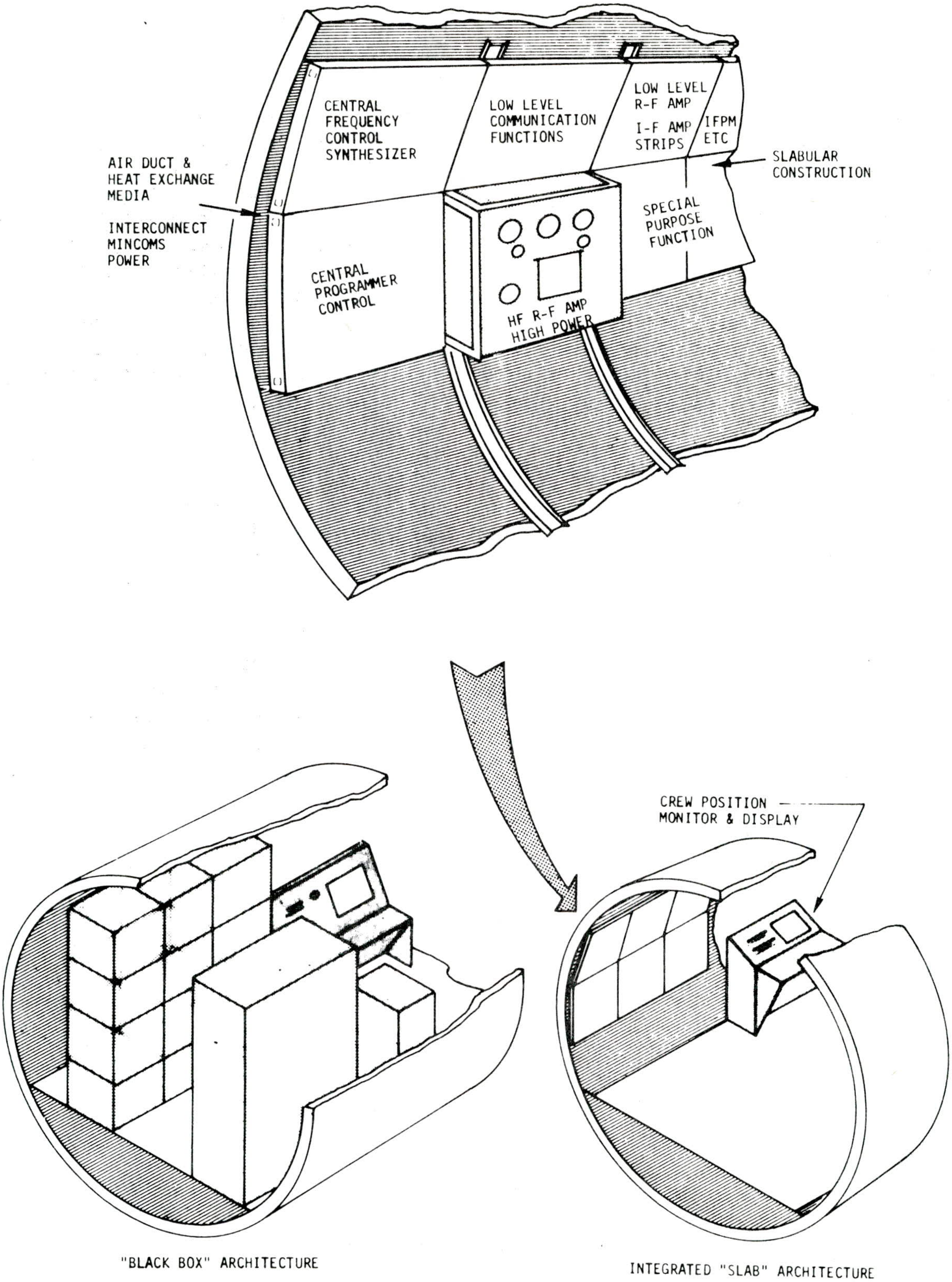


Diagram of the NAVAIRDEVCEN Integrated Avionics System Architecture (IASA) Concept

The use of large-scale integrated circuit techniques and other foreseeable state-of-the-art microelectronics technology are used in the construction of the system. Integrated control panels provide the crew members with access to the computer, programmer, and equipment functions. The concept will provide a Navy aircraft with electronics architecture constructed as functional "slabs" using microelectronics techniques and mounted along the airframe, rather than the "black box" concept. Cooling and interconnections are channeled about the airframe and are an integral part of the airframe.



Conceptual Illustration of Integrated "Slabular" Architecture

ADVANTAGES

The use of the IASA concept for the construction of future aircraft electronics systems affords the advantages that have been the goals in many subsystem concepts. The system becomes adaptable to changes in the tactical environment by programming the central programmer to reconfigure the functional "slabs" to the required situation. Aircraft maintenance aboard a carrier can be facilitated by using continuous monitoring and reporting of system performance, and identification of system failures. This knowledge can be used to replace modules or functional elements during aircraft turnaround time. Operators and maintenance personnel will not have to be as highly skilled, and fewer will be needed. If a failure were to occur during a flight, the programmer will select alternate paths automatically to continue system operation.

The MINCOMS "highway" will provide low level, solid state control of all internal and external communications, both man-to-machine and machine-to-machine, including the processing, distribution, and display of all sensor information; all electric power generation and distribution within the aircraft; as well as integration of aircraft flight instruments, cockpit displays, monitoring engine performance systems, and the status displays and control of the weapons systems.

Additionally, MINCOMS and functional units with microminiature electronics have high inherent reliability, and can be replaced quickly when necessary. They thus eliminate the extremely time consuming and costly fault tracing, wire replacement, and multipin connector replacement inherent in today's multiconductor "hand-wired" cable systems.

In summary, IASA will:

1. increase flexibility, expansion capability, compatibility, and reliability of all avionics systems;

2. increase probability of mission accomplishment;

3. reduce size and weight requirements; and

4. decrease maintenance, aircraft down time, and life time cost.

APPLICATION

The 1975-85 era aircraft for such future airborne weapon systems as the Air-to-Air Weapons Control System (AAWCS) and the Airborne Tactical Control System (ATCS), are excellent candidates for full application of the IASA concept. The heart of the concept is a control programmer, and

full use can be made of the functional computer, known as the Advanced Avionics Digital Computer (AADC).

Integrated antennas could be used for the subsystems, and the AADC through MINCOMS would control these subsystems, placing them in their respective functions at the appropriate time. The data gathered through these subsystems, plus other data such as weapons status, engine performance, and electronics subsystem status, could be displayed on integrated, flat plate, display panels. The aircraft electrical system could be controlled through a newly proposed Advanced Aircraft Electric System concept, reference (a). The airfoil control could be accomplished through digital information, and might be performed through the AADC or manual control.

CONCLUSIONS

The ever increasing sophistication of Navy aircraft to meet defense requirements places an equivalent burden upon research and development to meet minimum size, weight, and maintenance demands with maximum performance and reliability. The NAVAIRDEVCEN Integrated Avionics System Architecture concept is considered to be an important step toward these goals.

R E F E R E N C E S

The following documents are applicable to the IASA concept or have supplied ideas during the formulation of the plan.

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